

AMENDMENT AND RESPONSE

Serial No.: 10/033,156

Filing Date: October 25, 2001

Title: SEALED NITRIDE LAYER FOR INTEGRATED CIRCUITS

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Attorney Docket No. 125.020US01

REMARKS

Applicant has reviewed the Office Action mailed on March 1, 2004 as well as the art cited. Claims 1-12 and 14-17 are pending in this application.

Rejections Under 35 U.S.C. § 102

Claims 1, 2, and 4 were rejected under 35 USC § 102(e) as being anticipated by Nordstrom et al., (U.S. 2001/0012655 A1).

Claim 1

Claim 1 is as follows:

1. (Previously presented) A method of forming a sealing nitride layer overlaying a oxide layer in a contact opening of an integrated circuit, the method comprising:
forming a second layer of nitride overlaying a first layer of nitride without any intervening layers between the first and second layers of nitride to form the sealing nitride layer, the second layer of nitride further overlaying and in contact with an exposed portion of a surface of a substrate in the contact opening and sidewalls of the contact opening; and
using reactive ion etching (RIE etch) without a mask to remove a portion of the second nitride layer adjacent the surface of the substrate in the contact opening to expose a portion of the surface of the substrate in the contact opening without removing portions of the second nitride layer covering the sidewalls of the contact opening.

In regards to Claim 1, the Applicant respectfully traverses the Examiners rejection of Independent Claim 1. Claim 1 includes elements not taught by the Nordstrom et al. reference. For example, Claim 1 includes the elements of "using reactive ion etching (RIE etch) without a mask to remove a portion of the second nitride layer adjacent the surface of the substrate in the contact opening to expose a portion of the surface of the substrate in the contact opening without removing portions of the second nitride layer covering the sidewalls of the contact opening," emphasis added. The Nordstrom et al. reference does not teach these elements. For example, referring to Figure 25a, and in particular, region 40" and the accompanying text in paragraph [0137], silicon nitride layer 44 (illustrated with a dotted line) is removed from the sidewalls (this is the same for region 31). Moreover, referring to region 36" of Figure 25a of the

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Nordstrom et al. reference, the etching of the oxide layer is stopped when the silicon oxide layer 42 is exposed. Please see paragraph [0137] of the Nordstrom et al. reference. Hence, a portion of the surface of the substrate is not exposed. Accordingly, the elements of "using reactive ion etching (RIE etch) without a mask to remove a portion of the second nitride layer adjacent the surface of the substrate in the contact opening to expose a portion of the surface of the substrate in the contact opening without removing portions of the second nitride layer covering the sidewalls of the contact opening," as disclosed and claimed in Claim 1 of the present application are not taught by the Nordstrom et al. reference.

Furthermore, another example of an element not taught by the Nordstrom et al. reference is the element "forming a second layer of nitride overlaying a first layer of nitride without any intervening layers between the first and second layers of nitride." The Examiner in the Response to Arguments, neglected to consider the intervening layers of 39 and 39 of Figure 25a of the Nordstrom et al. reference. Since as shown above, not every element of Claim 1 is taught by the Nordstrom et al. reference, the rejection of Claim 1 under 35 USC § 102(c) is improper.

Therefore, the applicant respectfully requests the withdrawal of the rejection of Claim 1 under 35 USC § 102(c). Moreover, since Claims 2-6 depend from and further define patentably distinct Claim 1, the Applicant also respectfully requests the withdrawal of these dependant claims. In addition, since the Applicant believes these dependant claims are allowable for the above reason, all of the rejections to said claims may not have been addressed in this response. However, the Applicant retains the right to address any said rejection if a further response is required.

Claim 4

Claim 4 is as follows:

4. (Original) The method of claim 1, wherein, at least a portion of the first layer of nitride remains overlaying the oxide layer after the RIE etch is applied.

In regards to the rejection of dependant Claim 4 under 102(e), Claim 4 includes the limitation, " wherein, at least a portion of the first layer of nitride remains overlaying the oxide layer after the RIE etch is applied." The Nordstrom et al. reference does not teach "wherein, at

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least a portion of the first layer of nitride remains overlaying the oxide layer after the RIE etch is applied," as is claimed in dependant Claim 4 of the present invention. For example, please refer to Figure 25(a) of the Nordstrom et al. reference and in particular silicon oxide 42 overlaying the surface of the substrate of Figure 25(a) and field oxide layer 18 which are not covered by at least a portion of the first layer of nitride. Also rcfcr to Figure 25(b) of the Nordstrom et al. reference and in particular what is marked as field oxide layer 18 and silicon oxide 39 which are not covered by at least a portion of the first layer of nitride 34. Moreover, please rcfcr to paragraph [0137] of the Nordstrom et al. reference where it states, "[t]he etching is stopped, when the surface regions of the field oxide layer 18 and of the silicon oxide layer 42 have been exposed." Since at least a portion of the first nitride layer 34 does not remain overlaying the oxide layer, the rejection of Claim 4 under 102(e) is improper and the Applicant respectfully request the withdrawal of rejection of Claim 4 under 35 U.S.C § 102(c).

Rejections Under 35 U.S.C. § 103

Claims 7-13 were rejected under 35 USC § 103(a) as being unpatentable over Nordstrom et al. A 103 rejection requires a *prima facie* showing that the art references suggested or provided motivation to modify the reference to establish obviousness under 103. A *prima facie* showing of obviousness further requires that that the prior art reference teach or suggest all of the claim limitations.

Claim 7

Claim 7 is as follows:

7. (Currently amended) A method of forming an integrated circuit, the method comprising:

forming a layer of oxide over a surface of a substrate;
forming a first layer of nitride overlaying the layer of oxide;
forming a contact opening through the first layer of nitride and the oxide layer to expose a portion of the surface of the substrate;

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forming a second layer of nitride overlaying the first layer of nitride, the second layer of nitride also overlaying the exposed portion of the surface of the substrate in the contact opening and sidewalls of the contact opening; and

using a reactive ion etch (RIE etch) without a mask on the substrate for a pre-determined amount of time to remove a portion of the second layer of nitride overlaying the surface of the substrate in the contact opening without removing the portions of the second nitride layer overlaying the sidewalls of the contact opening and without removing portions of the first nitride layer overlaying the oxide layer, wherein the oxide layer is sealed by the first and second nitride layers.

The Applicant respectfully traverses the Examiner's rejection of Claim 7 under 35 USC 103. Claim 7 has been amended to further clarify the differences between the preset application and the cited art references. Claim 7 includes elements not taught by either Nordstrom et al. nor the Wu references. For example, the Nordstrom et al. reference neither alone nor in combination teaches or suggests "using a reactive ion etch (RIE etch) without a mask on the substrate for a pre-determined amount of time to remove a portion of the second layer of nitride overlaying the surface of the substrate in the contact opening without removing the portions of the second nitride layer overlaying the sidewalls of the contact opening and without removing portions of the first nitride layer overlaying the oxide layer, wherein the oxide layer is sealed by the first and second nitride layers," emphasis added, as is disclosed and claimed in Claim 7 of the present application. For example, please again refer to Figure 25(a) of the Nordstrom et al. reference and in particular silicon oxide 42 overlaying the surface of the substrate of Figure 25(a) and field oxide layer 18. Moreover, please refer the alternative embodiment in Figure 25(b) of the Nordstrom et al. reference and in particular disposable spacer oxide 148, silicon oxide 39 as well as field oxide 18. Referring to paragraph [0137] of the Nordstrom reference it states "[t]he etching is stopped, when the surface regions of the field oxide layer 18 and of the silicon oxide layer 42 have been exposed." Hence, exposing the oxide layers 18 and 42 in the Nordstrom et al. reference is contrary to what has been disclosed and what is claimed in Claim 7 of the present application. As discussed in the specification, one of the purposes of the present invention is to seal an oxide layer with nitride layers to provide an effective ion barrier. See Paragraphs 0005, 0006 and 0027 of the present application. This is not the objective of Nordstrom et al. reference. See the objects of the invention as set out in the summary sections in paragraphs 0019-0027 of

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the Nordstrom et al. reference. Thus, there is no motivation or suggestion in the Nordstrom et al. reference to modify the reference to what is claimed in the present application since the Nordstrom et al. reference is addressing other problems than what the present application is addressing. Accordingly, the Nordstrom et al. reference does not teach or suggest every element of Claim 7 as pointed out above, the rejection of Claim 7 under 35 U.S.C. 103(a) is improper.

Moreover, since Claims 8-13 depend from and further define patentably distinct Claim 7, Applicant asserts that these claims are also allowable and respectfully requests the withdrawal of the rejection of Claims 8-13. Since dependent claims 8-13 are believed allowable for the above reasons, Applicant has not addressed some of the further rejections to the dependent claims but retains the right to address said rejections if a future response is necessary.

Claims 14-18 were rejected under 35 USC § 103(a) as being unpatentable over Nordstrom et al. in view of S. Wolf and R.N. Tauber ("Silicon Processing for the VLSI Era: Volume 1 - Process Technology," Lattice Press, Sunset Beach, CA (1986), pgs 321-324). A 103 rejection requires a *prima facie* showing that the art references suggested or provided motivation to modify the reference to establish obviousness under 103. A *prima facie* showing of obviousness further requires that the prior art reference teach or suggest all of the claim limitations.

Claim 14

Claim 14 is as follows:

14. (Currently amended) A method of forming semiconductor devices in an integrated circuit comprising:

forming a plurality of device regions of a first conductivity type in a substrate adjacent a surface of the substrate;

forming an oxide layer over a surface of a substrate;

patternning the oxide layer to expose pre-selected portions of the surface of the substrate;

forming a first layer of nitride overlaying the oxide layer and the exposed portions of the surface of the substrate;

implanting ions of a second conductivity type through the layer of nitride into the substrate to form device regions of the second conductivity type, wherein remaining portions of the oxide layer under the nitride layer selectively stop the ions from entering

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the substrate to selectively define edges of the device regions of the second conductivity type;

forming contact openings to expose a portion of each of the device regions of the first and second conductivity type in the substrate;

forming a second layer of nitride over the first layer of nitride, the second layer of nitride also overlaying the exposed portions of each of the device regions in their associated contact openings and sidewalls of each of the contact openings; and

exposing the substrate to a reactive ion etch (RIE etch) for a pre-determined amount of time to remove portions of the second layer of nitride adjacent a surface of each device region in an associated contact opening, wherein the substrate is not exposed to the RIE etch long enough to remove all of the portions of the second nitride layer overlaying the respective sidewalls of each of the contact openings and portions of the first layer of nitride overlaying the oxide layer so that the oxide layer remains sealed by the first and second layers of nitride.

The Applicant traverses the rejection of Claim 14 under 35 U.S.C. 103. Claim 14 has been amended to further clarify that the oxide layer remains sealed by the first and second layers of nitride. Neither the Nordstrom et al., the Wolf nor the Tauber reference teach or suggest this element of Claim 14. In particular, please refer to Figure 25(a) of the Nordstrom et al. reference and in particular silicon oxide 42 overlaying the surface of the substrate of Figure 25(a) and field oxide layer 18 (both of which are not sealed by a nitride layer. Moreover, please refer the alternative embodiment in Figure 25(b) of the Nordstrom et al. reference and in particular disposable spacer oxide 148, silicon oxide 39 as well as field oxide 18 which are not sealed by a nitride layer. Referring to paragraph [0137] of the Nordstrom reference it states “[t]he etching is stopped, when the surface regions of the field oxide layer 18 and of the silicon oxide layer 42 have been exposed.” Hence, exposing the oxide layers 18 and 42 in the Nordstrom et al. reference is contrary to what has been disclosed and what is claimed in Claim 14 of the present application. As discussed in the specification, one of the purposes of the present invention is to seal an oxide layer with nitride layers to provide an effective ion barrier. See Paragraphs 0005, 0006 and 0027 of the present application. This is not the objective of Nordstrom et al. reference. See the objects of the invention as set out in the summary sections in paragraphs 0019-0027 of the Nordstrom et al. reference. Thus, there is no motivation or suggestion in the Nordstrom et al. reference to modify the reference to what is claimed in the present application since the

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Nordstrom et al. reference is addressing other problems than what the present application is addressing.

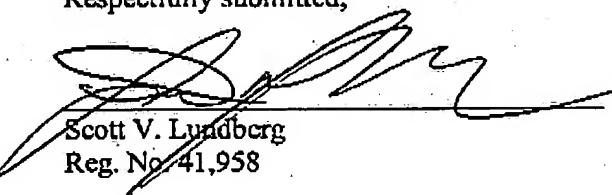
Accordingly, Applicant respectfully requests the withdrawal of the rejection of Claim 14 under 35 U.S.C. § 103. Moreover, since Claims 15-18 depend from and further define patentably distinct Claim 14, Applicant asserts that these claims are also allowable and respectfully requests the withdrawal of the rejection of Claims 15-18. Since defendant claims 15-18 are believed allowable for the above reasons, Applicant has not addressed further rejections to the defendant claims but retains the right to address said rejections if a future response is necessary.

CONCLUSION

Applicant respectfully submits that claims 1-12 and 14-17 are in condition for allowance and notification to that effect is earnestly requested. If necessary, please charge any additional fees or credit overpayments to Deposit Account No. 502432.

If the Examiner has any questions or concerns regarding this application, please contact the undersigned at (612) 455-1682.

Respectfully submitted,



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